Dynamic Sampling Interface for Sample Monitoring/Analysis (#7944, 7904)

A real-time sampling interface providing non-invasive, rapid sampling from bioreactors with independent flow control for direct coupling with inline treatment and analysis.

Inventors at Georgia Tech have constructed the Dynamic Sampling Interface (DSI) that integrates with a range of bioreactor geometries to provide non-destructive sampling with high spatial and temporal resolution, down to the level of a single cell. The DSI fits in-between the bioreactor and the sample treatment/analysis workflows, and is designed to couple with any liquid based analytical method. The key elements include: (1) a pump with highly timed resolved pressure differential based sampling and tunable flow rates, (2) a valve to switch between the sampling volume and analysis outlet, importantly decoupling flow rates during sampling and analysis, (3) a multi-stage filtration system for liquid-liquid or liquid-solid separation methods in-line with sampling, (4) a liquid medium or stream representative of the sample (cell bioreactor), (5) a non-fouling, non-invasive, spatially resolved inlet for localized sampling to be inserted directly into element 4, and (6) the ability to switch between different analytical methods without changing the sample. The sampling interface has an excellent temporal response due to a minimum dead volume design with tunable sampling rates for rapid sampling and spatially resolved inlet.

Benefits/Advantages

- **Sampling efficiency** – ability to independently set sampling flow rate and analysis flow rate
- **Non-invasive/non-destructive** – minimum volume samples and mitigation of contamination during sampling
- **Drop-in design** – integrates easily with a range of sample volume geometries
- **High spatial & temporal resolution** – probe spatial variations due to a maneuverable sampling inlet.

Potential Commercial Applications

- Bioreactor monitoring for therapeutic cells
- Bio-manufacturing (e.g. biologics production)
- Cell manufacturing processes
- Sampling interface
    - Mass spectrometry
    - Nuclear magnetic resonance spectroscopy (NMR)

- Scanning electron microscopy (SEM)

Background/Context for This Invention

Therapeutic cell technologies present a new frontier in powerful treatments of life threatening illnesses. Emerging cell therapies engineer cells (either taken directly from a patient or from a donor) that provide a powerful treatment of previously incurable ailments. Clinical production of therapeutic cells at scale necessitates the use of high volume bioreactors (where the cells are grown), which inherently have large spatial and temporal variations both biochemically and physically. The ability to monitor the local biochemical state of cell bioreactors is critical for rapid development and widespread utilization. Molecules secreted by cells during growth can be linked to cell health, efficacy, and potency but are currently monitored with methods that are destructive, time consuming, and incapable of providing any feedback control during production. More importantly, the commonly used analytical methods provide average readings of biochemical content, and are unable to probe local heterogeneities that are paramount to understanding the cell growth trajectory. The ability to provide non-destructive, localized sampling coupled with real-time monitoring of all bio-molecules with high specificity and sensitivity is key to the scale up and scale out of cell therapies, allowing these potent treatments to reach a broader audience.

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More Information

Publications

For more information about this technology, please visit:
https://licensing.research.gatech.edu/technology/dynamic-sampling-interface-sample-monitoringanalysis

Images:

The automated sequential delivery of multiple fluids. A varying number of delay gates imprinted in the branches are shown in the figure.

COVID-19 and flu saliva test on paper: (A) The automatic sequential delivery of multiple reagents required for virus test; (B) Water pouring into the device triggers the virus assay, allowing the presence of SARS-CoV-2 and influenza A & B viruses to be visually identified by the color changes in the corresponding detection spot